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TEXT COMPREHENSION PROCESSES IN BILINGUALS(U) NAVY
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F R CHANG ET AL. AUG 85 NPRDC-TR-85-34

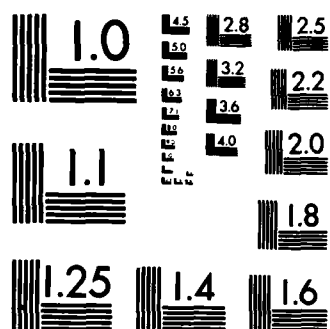
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AUGUST 1985

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TEXT COMPREHENSION PROCESSES IN BILINGUALS

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**Navy Personnel Research and Development Center
San Diego, California 92152-6800**

AD-A158597

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE				
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NPRDC TR 85-34		5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION Navy Personnel Research and Development Center	6b. OFFICE SYMBOL (if applicable) Code 51	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) San Diego, CA 92152-6800		7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Office of Naval Research	8b. OFFICE SYMBOL (if applicable) ONR-270	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) Arlington, VA 22217		10. SOURCE OF FUNDING NUMBERS		
		PROGRAM ELEMENT NO. RF63-522	PROJECT NO. 801	
		TASK NO. 011	WORK UNIT ACCESSION NO. 03.05	
11. TITLE (Include Security Classification) ES TEXT COMPREHENSION PROCESS IN BILINGUALS				
12. PERSONAL AUTHOR(S) Chang, Frederick R. and Lare, Cosette M.				
13a. TYPE OF REPORT Interim Report	13b. TIME COVERED FROM 84 Mar TO 84 Sep	14. DATE OF REPORT (Year, Month, Day) 1985 July AUG.	15. PAGE COUNT 18	
16. SUPPLEMENTARY NOTATION See NPRDC TR 85-9, Reading and Listening Processes in Bilinguals, for related research.				
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Bilingual education, adult education, text comprehension.		
FIELD	GROUP			SUB-GROUP
05	09			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The text comprehension abilities of Navy recruits who speak English as a second language (ESL) were investigated in two experiments. In Experiment 1, Tagalog-English-speaking recruits from the Philippines and native English speaking (NES) recruits were compared on a letter-cancellation task. Both groups gave similar amounts of attention to important versus unimportant words. In Experiment 2, ESL-NES groups were compared on the ability to detect the words, sentences, and paragraphs within a page of run-on text. Differences in word detection were minor compared to the vast, unusual, and patternless errors for sentences and paragraphs by the ESL group. These results, taken together with those of earlier research, suggest that greater gains in ESL reading ability can be had through more training in higher-level paragraph comprehension skills, rather than just decoding and vocabulary.				
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Frederick R. Chang		22b. TELEPHONE (Include Area Code) (619) 225-6434	22c. OFFICE SYMBOL (Code 51)	

FOREWORD

This research was conducted within task area RF63-522-801-011 (Enhancing Basic Skills), work unit 03.05 (utilization of bilingual Navy personnel). The objective of this work unit is to understand and improve the communicative competence of bilingual Navy personnel who speak English as a second language.

This is the second in a series of reports concerning bilingual recruits' comprehension of English. The first report (NPRDC Tech. Rep. 85-9) examined the reading and listening processes of native English-speaking recruits and those who speak English as a second language.

The results of this study are intended for those studying the reading and language problems of bilingual U.S. populations. Appreciation is extended to Master Chief David Richie and the staff of the Academic Remedial Training Center, San Diego for their support and cooperation in the successful completion of this research.

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SUMMARY

Problem and Background

The increasing number of recruits who speak English as a second language (ESL) has important implications for Navy training and manpower programs. Although these recruits often possess desirable traits of patriotism, diligence, and respect for authority, they also have higher attrition and lower promotion potential. Poor reading ability, a definite handicap in using long and complex Navy technical manuals, is an important factor in lowered job proficiency by ESL or any other recruits.

Previous research has shown that the text comprehension of bilinguals is worse than that of marginally literate native-English-speaking (NES) recruits (Chang, 1984). This difference held for both auditory and visual presentations, and the ESL-NES vocabulary difference alone was insufficient to account for the large difference in comprehension. Interestingly, ESL and marginally literate NES groups performed equally well on speeded tests of word decoding.

Objective

The present research investigated some of the potential causes of comprehension difficulties by ESL recruits: the distribution of attention across words in a text and the integration of information across sentences into paragraphs.

Approach

The cognitive performance of ESL recruits and marginally literate NES recruits was compared in two experiments. Experiment 1 investigated how subjects allocate their attention across individual words in a text. Recruits were given typed, double-spaced passages and asked to cross out all occurrences of a target letter (e). This experiment was based on the premise that the pattern of errors in this task reveals how subjects allocate their attention across words. Prior research has shown that skilled readers miss more target letters in unimportant, function words (e.g., "the") than content words (e.g., "get"), suggesting that skilled readers do not allocate their attention evenly.

Experiment 2 examined how the subjects integrate the information from sentences to understand a paragraph. Individual paragraphs on four different subjects were presented sequentially on a single page with all white space, indentation, punctuation, and capitalization removed. Subjects were asked to mark word, sentence, and paragraph boundaries. Performance on the paragraph task was of primary importance for insight into how readers integrate information.

Results

1. Experiment 1 showed that ESL and NES recruits do not differ in the amount of attention they give to the important words of text--both groups missed more target letters "e" in unimportant words.
2. Experiment 2 showed that ESL and NES groups differ widely in their ability to integrate information across sentences into paragraphs. The ESL group was much worse than the NES group on the paragraph boundary task (42% versus 17% errors), suggesting that they had considerable difficulty in determining where one topic ended and another

began. In contrast, the error rate for words was low for both groups, only 5 percent for ESL and 2 percent for NES recruits. Figure 1 illustrates the overall pattern of Experiment 2 results.

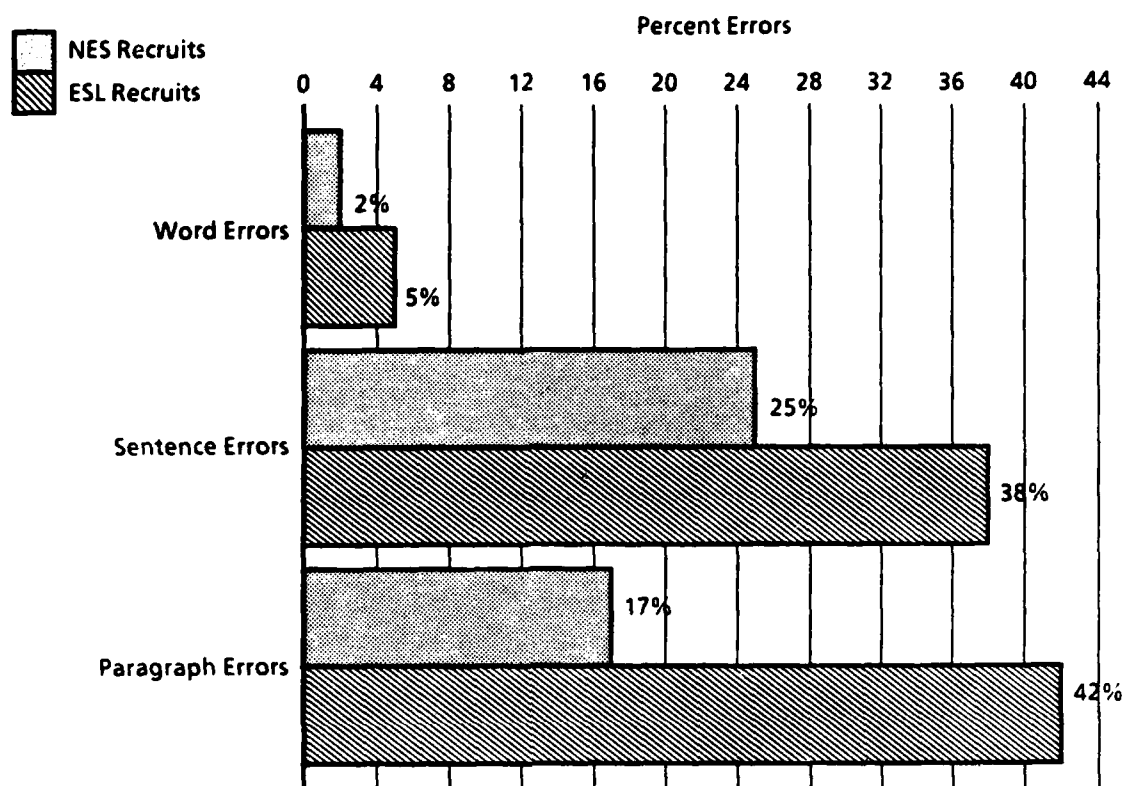


Figure 1. Percent errors on word, sentence, and paragraph tasks by native English speakers (NES) and English as a second language (ESL) speakers in Experiment 2.

Conclusions

The results of this study together with the earlier empirical research (Chang, 1984) with ESL recruits suggest the types of assistance these recruits may or may not need. Since ESL recruits performed as well as the NES recruits in lower-level decoding and surface structure reading tasks, these processes do not seem to need remediation. The difference in vocabulary knowledge between the groups could not account for the differences in higher-level comprehension and integration. Providing ESL recruits with special training in higher-level comprehension and integration tasks is where we are likely to obtain the greatest gains in reading ability.

Although much remains to be learned about the language processing of ESL recruits before we can realize substantial training benefits, the results of these studies have some implications for Navy training.

1. Special training for ESL recruits should increase the amount of instruction in higher-level comprehension skills.
2. Research programs should continue to examine how ESL readers integrate information across a text.

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INTRODUCTION

Problem

The current rise in the number of Spanish-speaking and other bilingual recruits in the Navy and the military in general, has important implications for Navy training and manpower programs. The Hispanic population, for example, is young and growing (from 7.0% of the U.S. population of 18-35 year old males in 1980 to a projected 10.8% in the year 2000), while the overall U.S. population is older and decreasing (Oxford-Carpenter, Pol, & Gendell, 1983).

Recruits who speak English as a second language (ESL) are a potentially valuable source of capable personnel. As personnel specialists have noted, the acculturation of Hispanic families in particular has often promoted patriotism, hard work, and respect for authority. Moreover, ESL personnel have a generally high level of motivation (Holland, Rosenbaum, Stoddart, & Redish, 1982).

Unfortunately, ESL recruits also tend to have higher attrition rates and reduced promotional potential and Navy effectiveness compared with native English-speaking (NES) recruits (Salas, Kincaid, & Ashcroft, 1980). One reason for these findings is that ESL personnel have lower reading skills than average Navy recruits (Fletcher, Duffy, & Curran, 1977). Since reading ability correlates positively with job proficiency (Sticht, 1975) and Navy manuals are often long and complex, the ESL reading deficit is worrisome. Thus, it is important to understand the text comprehension skills of ESL recruits and determine how to improve them. The research presented here is part of a larger research project aimed at understanding and improving the communicative competence of bilingual personnel.

Background

Chang (1984) found that the text comprehension of bilingual Navy recruits was worse than that of a group of marginally literate NES recruits. This difference was found for both auditory and visual presentation of the passages and did not seem to be due solely to a lack of vocabulary knowledge on the part of the ESL recruits. When recruits were tested on the words that occurred in the passages, the ESL recruits knew most of the words. Vocabulary knowledge obviously plays a crucial role in paragraph comprehension, but in these passages and with these ESL recruits additional influences were at work. Both groups of subjects also performed identically on tests of speeded decoding. Decoding ability did not differentiate the groups and, therefore, could not have accounted for the paragraph comprehension differences.

Objective

The objective of the present research was to investigate some of the causes of differences in text comprehension performance between NES and ESL recruits. In particular, this study investigated the recruits' distribution of attention across words in a text and the role of integrating information across sentences in a text.

EXPERIMENT 1. DISTRIBUTION OF ATTENTION ACROSS WORDS IN A TEXT

The first experiment investigated ESL recruits' distribution of attention across words in a text. One reason that comprehension performance of the ESL subjects was worse

than that of the NES subjects in the original Chang (1984) study might have been that the ESL subjects processed each word in text uniformly. That is, ESL subjects might have been insensitive to the fact that some words in a text are not as important for understanding the text as are others.

Skilled NES readers do not distribute their attention evenly across words in a text. A whole host of studies using on-line measurement techniques (cf. Chang, 1983) suggest that readers do not process all words in a text uniformly. Readers' eye-movement patterns in text are influenced by text difficulty (Judd & Buswell, 1922) and grammatical structure (Wanat, 1976). Individual word reading times vary with grammatical structure and word type (Aaronson & Scarborough, 1976). NES subjects who were instructed to cross out all occurrences of a target letter (e.g., the letter e) in a text (Corcoran, 1966; Healy, 1976) missed more target letters in function words (e.g., the) than in content words.

This experiment expanded on the work of Corcoran (1966), Healy (1976), and others. The basic premise was that, when subjects are instructed to scan a text for a target letter (e.g., e), the pattern of words containing missed targets reveals how the subjects allocate their attention across the words.

As in previous research (Chang, 1984), this research adopted an individual differences approach (cf. Frederiksen, 1980; Graesser, Hoffman, & Clark, 1982; Jackson & McClelland, 1975, 1979) and compared a group of ESL recruits with a group of marginally literate NES recruits. A group of ESL and a group of NES recruits were instructed to cross out the letter e in reading materials similar to those they use in recruit training. This method was intended to uncover differences in how ESL subjects process the function word "the" (which contains the target letter e), as opposed to content words containing the target letter, compared to the NES subjects. Control conditions that ruled out differences based on nonlinguistic factors (i.e., word length or letter position) were included. Moreover, since the letter e is pronounced in some words (speak) and not pronounced in others (done), it is possible to investigate the role of a phonetic code (cf. Kleiman, 1975; Levy, 1977; Posner, 1978) in the reading performance of ESL and NES subjects.

Method

Subjects

The subjects in this experiment were 15 monolingual, English-speaking and 17 bilingual, English-Tagalog-speaking Navy recruits at the Academic Remedial Training (ART) Center at the San Diego, California Recruit Training Command (RTC).

In general, there are three ways by which a recruit is assigned to the ART program. During the first week of normal Navy recruit training, all recruits are given the Gates-MacGinitie Reading Test (1978). If a recruit scores above 6.0 in reading grade level (RGL), he is processed directly through regular training. If he scores below 6.0 RGL, he is retested the next day on another form of the Gates-MacGinitie test for confirmation of the reading weakness. If he scores between 4.0 and 6.0, he is directly enrolled in ART. If he scores below 4.0, he is referred to a review board and may be enrolled in ART. A recruit who scores above 6.0 may also be referred to ART if he fails one or more of his recruit training tests. It should be pointed out that at the San Diego RTC, the 6.0 RGL cutoff has recently been moved up to 7.5. The Gates-MacGinitie RGLs for the NES group in the present experiment ranged from 5.4 to 10.7 with a mean of 7.6; for the ESL group, the RGLs ranged from 3.2 to 7.9 with a mean of 5.4. The means differed significantly ($t(30) = 4.31, p < .001$).

We did not have any data on the reading ability of the ESL recruits in their native language, Tagalog, although we were told by the ART staff that it should be good. According to the ART staff, all the ESL recruits had high school diplomas, many of them had attended college, and some had 4-year college degrees.

Materials

The materials used in this study were the same as those used in the decoding section of a previous study (Chang, 1984; see also Sticht & Beck, 1976) and were about first aid. Two paragraphs from materials similar to those used in recruit training, one containing 334 words and the other 343 words, were typed double-spaced onto sheets of paper. The reading grade level of the paragraphs was 8.1 as measured by the Kincaid readability score. An alternate version of each paragraph was created in which the position of the letter e or E was held constant and the remaining letters in the word were scrambled. Thus, in the scrambled versions of the paragraphs, the word the became "hte." In the two paragraphs, the letter e occurred 365 times with 61 of them in the word "the."

Procedure

The recruits were tested in groups of four. Each recruit was given a packet of four photocopied pages: Page 1 was the normal text version of the first paragraph; page 2, the scrambled version of the second paragraph; page 3, the normal text version of the second paragraph; and page 4, the scrambled version of the first paragraph. The recruits were told to read each page as quickly and accurately as possible and circle every upper and lower case e, not to go back to circle any e they had missed, and to raise their hand upon completion of the task. The experimenter called out the time every 15 seconds to emphasize the importance of speed and recorded the time when the subjects completed each task.

Results and Discussion

Table 1 presents, by condition, the percentage of the total number of the letters e each group cancelled. Both groups missed more letters e in the word "the" than in the other words in the text when the text was presented normally. However, when the text was scrambled, cancelling the letter e in "hte" was no more difficult than cancelling the letter e in other letter strings. Thus, mere string length or letter position cannot account for the "the effect" in normal texts. This pattern was the same for both groups. The results showed a significant word type (the-hte or other) by text type (normal or scrambled) interaction ($F(1,30) = 78.3$, $MSe = 106.62$ $p < .001$), but no interaction with language group.

Table 1
Results of Cancelling Letter Task (Experiment 1)

Subject Group	Accuracy for Cancelling e by Boundary Type (%)			
	Normal		Scrambled	
	"the"	Other	"hte"	Other
NES	63.1	94.9	93.4	95.0
ESL	56.1	96.3	90.7	96.7

The results suggest that ESL and NES recruits distribute their attention similarly across the words in a text. One explanation of these results is that the ESL recruits know about the syntactic role of many lexical items, just as NES recruits do and that they use this knowledge in text processing. Although they cannot necessarily explain the rules of English syntax, ESL recruits appear to have at least some tacit knowledge about the importance of some words to a text.

An alternative explanation of the findings concerns subjects' relative reliance on a phonological code in reading (Kleiman, 1975; Levy, 1977; Posner, 1978). This explanation says that how individual words are pronounced is important--and not syntactic structure. Thus, in this view, reduced performance on the word "the" in normal texts is not due to syntactic factors, but because the word "the" contains an unpronounced e. If subjects rely on a phonological code to perform this task, they may skip the word "the." Carrying this line of thought further, the poor performance of the NES recruits may be due to syntactic factors, while that of the ESL recruits may be based on phonological factors.

It is relatively simple to address the phonological code interpretation by looking at the proportion of pronounced e and unpronounced e errors for both groups of subjects. All words containing the letter e (except the word "the") were classified into two groups: those with the long /e/ sound and those without. The word "the" was excluded from the analysis to get a measure of pronounceability (either a long /e/ or not) that was free from the syntactic role of the word "the." Sixty-six words contained the long /e/ sound and 238 did not.

For the NES subjects, the accuracy was 98.6 and 93.6 percent for pronounced and unpronounced items respectively. For the ESL subjects, the corresponding values were 98.6 and 96.9 percent. There was a main effect of pronounceability ($F(1,30) = 28.0$, $MSE = 11.69$, $p < .001$), but more importantly, there was a significant native language by pronounceability interaction ($F(1,30) = 7.36$, $MSE = 11.69$, $p < .02$). Though the effects are small in magnitude, the fact that NES subjects made more errors on words containing unpronounced letters e suggests that they--and not the ESL subjects--rely more heavily on a phonological code.

The effects of pronounceability are rather small compared to the effects of grammatical structure (3.2% versus 36.2%); thus, while the "the effect" for normal texts may be influenced by phonological coding, a phonetic code is not likely to play a large role in this task.

Another explanation for the similar performance of the two groups in this task is simply how much time was spent on the task. The ESL subjects might have simply devoted more time to the task, thus improving their performance relative to the NES subjects. In fact, this was not the case. The ESL subjects completed the e detection task on the normal and scrambled passages in 352 and 362 seconds respectively; and the NES subjects, in 416 and 432 seconds respectively. The ESL advantage was significant ($F(1,30) = 6.33$, $MSE = 11225$, $p < .05$). Also, both groups completed the normal passages faster than the scrambled passages ($F(1,30) = 7.00$, $MSE = 40.12$, $p < .05$). The interaction did not approach significance.

Overall, these findings suggest that these Tagalog-speaking ESL recruits as well as the NES recruits are sensitive to the syntactic role certain words play in a text. Perhaps this is explained by the fact that these recruits had received quite a lot of formal instruction in reading in English in the Philippines. Although this instruction was evidently at a rather mechanical (decoding) level, they apparently learned that some

lexical items are more important to the text than are others. To be sure, the task performed in this experiment was not normal reading; thus, any generalizations to actual reading must be made cautiously. However, the task does give insight into the automaticity (Frederiksen, 1980; Posner, 1978) of syntactic processing and how subjects allocate their attention through words in a text--both are clearly important components of reading.

The results from this experiment in combination with earlier research (Chang, 1984) suggest that lower level decoding and lexical knowledge factors do not seem to distinguish the ESL subjects from the NES subjects. This suggests that research should focus on higher level comprehension factors. One of these factors, how recruits integrate information across sentences in a text in order to construct a coherent meaning of what was read, was addressed in Experiment 2.

EXPERIMENT 2. INTEGRATION OF INFORMATION ACROSS SENTENCES IN A TEXT

Our informal observations of the paraphrasing abilities of the subjects in these studies revealed an interesting difference between ESL and NES groups: When given a brief passage to read and paraphrase, most NES subjects provided generally the same sort of paraphrase. That is, the paraphrases typically did not vary a great deal between subjects. The ESL subjects' paraphrases, on the other hand, did vary, because each interpreted the passage differently. They seemed to know what individual words and even sentences meant, but had trouble integrating the meaning across an entire passage.

Meaning integration is a critical skill in the comprehension of text. Skilled readers must integrate currently read (or "new") information with previously read (or "given") information (Haviland & Clark, 1974). As readers determine the meaning of each successive sentence in a text, they must incorporate the current meaning with the interpretation they presently have of the text. They must modify their present interpretation based on the new material and incorporate additional text into the revised interpretation. If, for some reason, a reader has difficulty integrating information appropriately, comprehension will breakdown. The passage may seem to be a sequence of unrelated sentences or a meaning different from the intended meaning may form in the mind of the reader.

The goal of Experiment 2 was to examine the integration process in a task that required subjects to detect "boundaries of meaning." A modified word boundary task (e.g., Hecker, 1982) similar to that used by Sticht (1974), was used. Subjects were presented with four paragraphs from very different sources on entirely different topics. These paragraphs were presented sequentially on a single page with all spaces, capitalization, punctuation, and hyphenation removed. The right and left margins of the text were justified. Subjects were instructed to identify word, sentence, and paragraph boundaries. The paragraph boundary task was considered to be of major importance. If ESL subjects have difficulty integrating meaning across sentences in a text, their performance on the paragraph task should be relatively poor compared to that of the NES subjects.

Method

Subjects

Twenty monolingual, English-speaking and 20 bilingual, English-Tagalog-speaking Navy recruits at the Academic Remedial Training Center, San Diego, California partici-

pated in Experiment 2. The general characteristics of the subjects were nearly identical to those of Experiment 1, and some of the subjects had participated in Experiment 1. The reading grade levels ranged from 5.4 to 10.7 with a mean of 7.6 for the monolingual subjects and from 3.2 to 8.8 with a mean of 5.7 for the bilingual subjects, as measured by the Gates-McGinitie Test. The means differed significantly ($t(38) = 3.89, p < .001$).

Materials

The stimulus materials consisted of four paragraphs taken from the United States Armed Forces Institute Intermediate Achievement Tests, Form C. The paragraphs contained a total of 25 sentences and a total of 318 words. The text was typed double-spaced with all punctuation, spaces, and indentations removed and was justified at both margins. The reading grade level of all the paragraphs was 4.1 as measured by the Kincaid readability score. The paragraphs were on reading instructions, stamp collecting, bats, and Louisa May Alcott.

Procedure

The subjects were tested in groups of eight. A photocopy of the text was given to each recruit. The subjects were instructed to read through the lines of text and put a slash mark between each word, a dot above the slash mark that separated two sentences, and an x above the dot that separated two paragraphs. The subjects were told that there were four paragraphs. To familiarize them with the task, the recruits were given instruction and practice on the first two sentences of the text. Subjects were given 30 minutes to complete the task.

Results and Discussion

For each of the three boundary tasks, subjects' data were scored by noting whether or not a boundary was detected; thus, only errors of omission were scored. The error data are presented in Figure 1 and show that the NES subjects performed more accurately on all three tasks. Comparisons between groups for each task verify the NES advantage ($p < .05$). The word difference, although statistically significant, was rather small. Both groups performed extremely well. The sentence and paragraph differences were larger.

The groups showed a larger difference on the sentence task than on the word task with the NES subjects again demonstrating superior performance. Thus, the ESL subjects had a bit more difficulty than did the NES subjects in determining within-sentence relationships. The upper limit of performance on the sentence task may not be 100 percent because the placement of sentence boundaries in naturally occurring text is somewhat arbitrary.

Of primary importance are the results from the paragraph task. As the text consisted of four paragraphs, there were three boundaries. Thus, each subject got either zero, one, two, or three boundaries correct. Thirteen of the 20 NES subjects got all three boundaries correct, four got two correct, three got one correct, and none missed them all. Only five of the 20 ESL subjects got all three boundaries correct, eight got two correct, four got one correct, and three missed them all. Thus, there was a rather large difference in the pattern of errors. All subjects had sufficient time to complete the task, as all finished it within the 30-minute limit.

All subjects had placed three paragraph boundary marks on their sheets. The pattern of boundary markers on the ESL sheets, however, did not show any consistent trend. That is, the subjects who made errors made them at different places in the text.

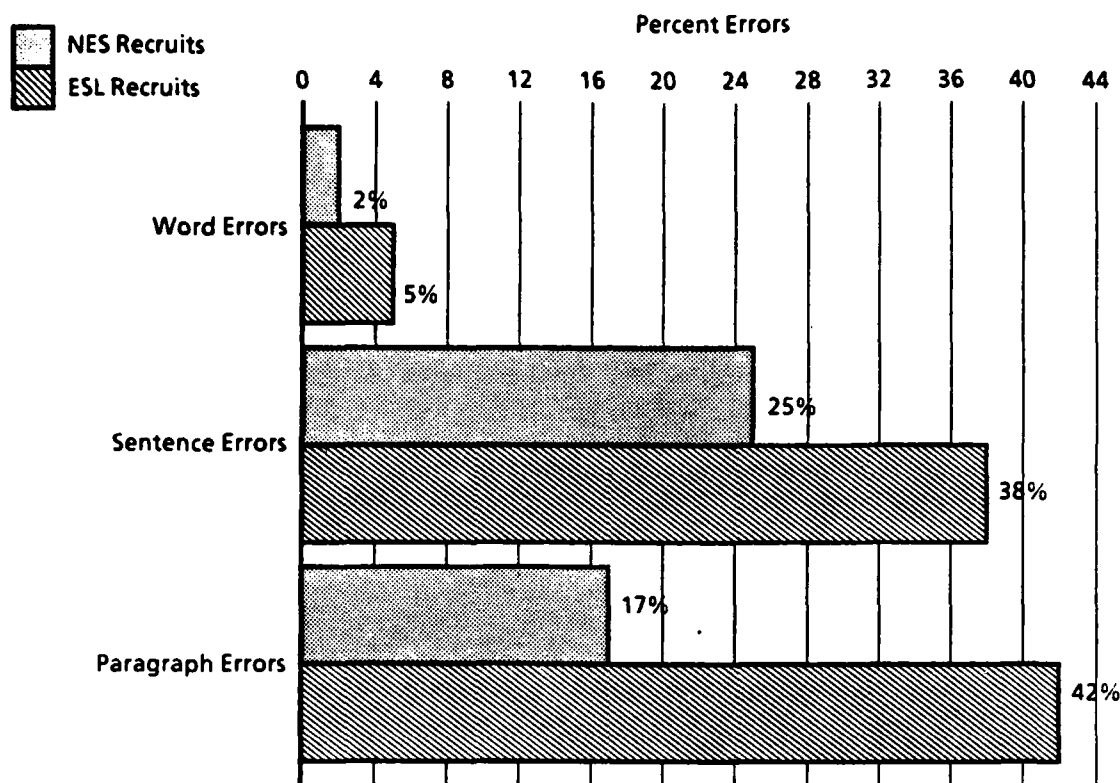


Figure 1. Percent errors on word, sentence, and paragraph tasks by native English speakers (NES) and English as a second language (ESL) speakers in Experiment 2.

The fact that many of the ESL subjects had difficulty with this task is potentially important and has several interesting, plausible interpretations. One is that the ESL subjects treat each sentence in isolation and, thus, have difficulty tracking textual coherence through a multisentence text. Another interpretation is that they lack a high level organizing structure to use in interpreting individual words in a text correctly and suppressing inappropriate meanings (Rumelhart, 1984). For example, in reading a passage about flying mammals, the ESL subjects may interpret the word bat to mean a wooden stick used to hit baseballs. That is, they were not able to use high-level contextual information appropriately to constrain the meaning of the word, even though they know that bat can be a flying mammal. This would clearly lead to comprehension differences and inappropriate interpretations.

A third interpretation is that ESL subjects may attempt to translate portions of the text into their native language. If the words do not have exactly the same meaning in both languages, inappropriate interpretations may arise. The translation could also lead to the ambiguity problem just mentioned. That is, the process of translating the word may give rise to only a single, dominant meaning.

Finally, to the extent that these passages are unfamiliar to the subjects because of cultural background differences, they may try to impose that background knowledge on the interpretation. People clearly impose such background structures on text and, in this case, they could lead to interpretative difficulty.

It is likely that some combination of these explanations accounts for the ESL paragraph boundary results. But the important point is that the subjects demonstrated profound interpretive difficulty, which has important training implications.

CONCLUSIONS

The results from these experiments in combination with the earlier empirical research with ESL recruits (Chang, 1984) suggest the types of assistance these recruits may or may not need. In lower-level decoding and surface structure (e.g., letter e cancellation) reading tasks, ESL and NES subjects perform similarly; thus, these sorts of processes do not seem to need remediation. In higher-level comprehension and integration tasks, the difference is profound, and out of proportion to the NES-ESL difference in vocabulary knowledge. Providing the ESL recruits with training in performing higher-level comprehension and integration tasks is where we are likely to obtain the greatest reading improvements.

In this study, as in the prior Chang (1984) study, the ESL and NES recruits performed similarly on some tasks. These tasks involved lower-level sorts of processes. On the basis of these findings, the ESL recruits do not seem to need training in lower-level reading processes. However, since the comparison group consisted of NES subjects from the Academic Remedial Training Center, perhaps some comment is warranted. That is, the reading ability of these NES subjects is not extremely high. While the reading ability of these NES subjects is below that of the average 18- to 23-year-old U.S. male population (the national average for this population is about 9.5 in reading grade level; cf Sticht, 1982, p. 11), they are not drastically lower. Moreover, in many respects, the NES results obtained in these studies are quite similar to those found using skilled adult readers.

Perhaps the most important finding from the present investigation was the result of the paragraph segmentation task in Experiment 2. The large difference found between the groups points out a profound comprehension failure. Several interpretations were proposed to account for the result. Since the different interpretations proposed suggest different training approaches, follow-on research is needed to pinpoint the source of the integration difficulty.

Although much remains to be learned about the language processing abilities of ESL recruits before we can expect to realize substantial training benefits, the results from these experiments have some implications for Navy training.

1. Remedial reading training for ESL recruits should concentrate on higher-level comprehension skills.
2. How ESL recruits integrate information across a text should continue to be examined.

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